

CHUKA

UNIVERSITY



## UNIVERSITY EXAMINATIONS

EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF  
SCIENCE IN CHEMISTRY

CHEM 361/CHIN 371: RESEARCH METHODS

STREAMS: BSC. CHEM

TIME: 2 HOURS

DAY/DATE: MONDAY 14/04/2025

8.30 A.M. – 10.30 A.M.

**INSTRUCTIONS**

- Answer all the questions in section I and TWO questions in section II
- Use of calculators and statistical tables is allowed.
- Do not write anything on the question paper.

**QUESTION ONE (30 MARKS): ANSWER ALL THE QUESTIONS**

- (a) Explain the following terms, giving their possible sources:
- |                         |           |
|-------------------------|-----------|
| (i) Experimental error. | (3 marks) |
| (ii) Sampling error     | (3 marks) |
- (b) Describe the types of data measurements. (6 marks)
- (c) Explain the key characteristics of the scientific method of inquiry. (6 marks)
- (d) Describe the process of identifying a research problem. (6 marks)
- (e) (i) Outline four characteristics of a researchable problem. (4 marks)
- (ii) Differentiate between dependent and independent variable. (2 marks)

**QUESTION TWO (20 MARKS)**

A researcher in an industrial chemistry laboratory plan to conduct an experiment using a Randomized Complete Block Design (RCBD) to evaluate the effectiveness of six different catalysts in a chemical reaction process.

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|---|-----------|
| a. Justify the suitability of RCBD for this experiment.   | (2 marks) |
| b. Advise a student on the appropriate layout of the experiment, including the arrangement of treatments and blocks in an industrial setting. | (9 marks) |

- c. Describe a suitable method for analyzing the data obtained from this experiment. (6 marks)
- d. Write the statistical model for RCBD. (3 marks)

**QUESTION THREE (20 MARKS)**

Four laboratories (A, B, C, and D) analyzed the concentration of cadmium (mg/kg) in soil samples, obtaining the following results:

Laboratories	Block 1	Block 2	Block 4
A	15	18	17
B	22	20	19
C	14	16	15
D	25	24	23

- (i) Perform the analysis of variance. Use  $\alpha=0.05$  and TSS = 158.00. (16 marks)
- (ii) Apply the Least Significance Difference (LSD) to separate the means of the laboratories. (4 marks)

**QUESTION FOUR (20 MARKS)**

(a) The following data was obtained from an experiment to determine the index of biotic integrity (IBI) of water quality in stream:

Distance	0	3	6	9	12	15	18
IBI	17	21	26	31	38	43	46

- (i) Fit a regression model. (7 marks)
- (j) Determine the IBI in the river 20 km downstream. (2 marks)
- (ii) Obtain a correlation coefficient. (3 marks)
- (b) Literature review is an important part of proposal writing. Discuss. (4 marks)
- (c) (i) Define Intellectual Property (IP) and explain its significance. (2 marks)
- (ii) List two reasons why Intellectual Property (IP) is important. (2 marks)
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